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XVII. *On ice found in the bottoms of rivers.* By T. A. Knight, Esq. F. R. S. *In a letter addressed to the Right Hon. Sir Joseph Banks, Bart. G. C. B. P. R. S.*

Read May 23, 1816.

DEAR SIR,

ACCOUNTS of ice having been found in the bottoms of rivers, have been so numerous, that the existence of it, in such situations, has ceased to be questioned, though no satisfactory hypothesis, relative to the manner in which it can be formed in, or conveyed to, such situations has, I believe, ever been offered. Indeed its existence in such situations does not appear to be a common occurrence, and possibly it has never been seen, during its progressive formation, by any person likely to trouble himself about the causes of its existence. I therefore take the liberty to submit the following account to your consideration.

I first witnessed the existence of ice in the bottom of the water in the river Teme, which passes near my residence in Herefordshire, in the last winter. In a morning which succeeded an intensely cold night, the stones in the rocky bed of the river, appeared to be covered over with frozen matter, which reflected a kind of silvery whiteness, and which, upon examination, I found to consist of numerous frozen spicula crossing each other in every direction, as in snow ; but not having any where, except very near the shore, assumed the

state of firm compact ice. The river was not, at this time, frozen over in any part; but the temperature of the water was obviously at the freezing point, for small pieces of ice had every where formed upon it in its more stagnant parts near the shores; and upon a mill pond, just above the shallow streams, (in the bottom of which I had observed the ice,) I noticed millions of little frozen spicula floating upon the water. At the end of this mill pond, the water fell over a low weir, and entered a narrow channel, where its course was obstructed by points of rock and large stones. By these, numerous eddies and gyrations were occasioned, which apparently drew the floating spicula under water; and I found the frozen matter to accumulate much more abundantly upon such parts of the stones as stood opposed to the current, where that was not very rapid, below the little falls, or very rapid parts of the river. I have reason to believe, that it would have accumulated in very large quantities, if the weather had continued sufficiently cold; for I had previously heard, from persons of respectable character, who had no interest, nor, I believe, intention, to deceive me, that, during a long and severe frost, some years ago, before I became an inhabitant of my present house, the whole bed of the river, in the part above-mentioned, had been covered over with a thick coat of ice. But it was not till the month of February that I witnessed the apparent deposition of ice in the manner which I have described; and as the day afterwards became bright, the spicula soon ceased to form, and the ice to accumulate; and before the middle of the day the greater part of it had disappeared.

Upon some large stones, near the shore, of which parts

were out of the water, and upon pieces of native rock, under similar circumstances, the ice beneath the water had acquired a firmer texture, but appeared from its whiteness, to have been first formed of congregated spicula, and to have subsequently frozen into a firm mass, owing to the lower temperature of the stone, or rock. Ice of this kind extended, in a few places, eighteen inches from the shore, and lay three or four inches below the level of the surface of the water, and did not dissolve nearly so rapidly as that which was deposited upon stones more distant from the shores.

The cause of the appearance of large quantities of porous ice, in some of the continental rivers, upon a thaw taking place after a long and severe frost, may, I conceive, be explained, without much difficulty, consistently with the foregoing hypothesis: for such ice would be removed by the increasing force of the rising water, and might be driven together in large masses, provided the temperature of the water were sufficiently low, and that it would be, if afforded by melting snow, or after having flowed over frozen ground. But there have been reports of large quantities of firm and solid ice having been found in this country at the bottom of deep and sluggish rivers, where there existed neither streams nor eddies to occasion the descent of frozen spicula from the surface of the water; and, if such ice have ever been found in such situations, it must be admitted, that it could not possibly have been conveyed there by the means above-mentioned.

I am, &c. &c.

T. A. KNIGHT.